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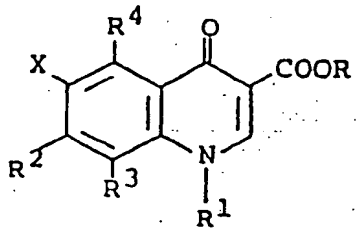
(54) Benzoheterocyclic compounds.

(57) Novel 4-oxoquinoline-3-carboxylic acid compounds of the formula:



[1]

wherein R^1 is cyclopropyl which may have 1 to 3 substituents of alkyl and halogen; phenyl which may be

EP 0 287 951 A2

11) 7-(3-Amino-1-pyrrolidinyl)-1-cyclopropyl-3, [illegible]-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 213-216°C, pale yellow powder (recrystallized from dimethylformamide)

12) 7-(1-Piperazinyl)-1-cycloprpyl-6-fluoro-8-chloro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 214-217°C, pale yellow powder (recrystallized from ethanol)

13) 7-(4-Methyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-8-chloro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 190-192°C, pale yellow powder (recrystallized from dichloromethane - n-hexane)

14) 7-(3-Methyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-8-chloro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

15) 7-(3-Amino-1-piperazinyl)-1-cyclopropyl-6-fluoro-8-chloro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

16) 7-(1-Piperazinyl)-1-cyclopropyl-5,6-difluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

17) 7-(4-Methyl-1-piperazinyl)-1-cyclopropyl-5,6-difluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

18) 7-(3-Methyl-1-piperazinyl)-1-cyclopropyl-5,6-difluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

19) 7-(3-Amino-1-pyrrolidinyl)-1-cyclopropyl-5,6-difluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

20) 7-(1-Piperazinyl)-1-cyclopropyl-5-chloro-6-fluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

21) 7-(4-Methyl-1-piperazinyl)-1-cyclopropyl-5-chloro-6-fluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 213-215°C, yellow crystals

22) 7-(3-Methyl-1-piperazinyl)-1-cyclopropyl-5-chloro-6-fluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

23) 7-(3-Amino-1-pyrrolidinyl)-1-cyclopropyl-5-chloro-6-fluoro-8-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

24) 7-Morpholino-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 245-247°C, white powder (recrystallized from ethanol)

25) 7-(3-Amino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid hydrochloride (trans form), m.p. 272-275°C (dec.), white powder (recrystallized from methanol - ethyl acetate)

26) 7-(3-Aminomethyl-1-pyrrolidinyl)-1-cyclo propyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid hydrochloride, m.p. 280-283°C (dec.), white powder (recrystallized from methanol - water)

✓27) 7-(4-Hydroxy-1-piperidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 220-221°C, colorless needles (recrystallized from methanol)

✓28) 7-(4-Fluoro-1-piperidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 204-207°C, white powder (recrystallized from ethanol)

29) 7-[3-(N-t-Butoxycarbonyl-N-methylamino)-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 210-212°C, white powder (recrystallized from ethanol)

30) 7-(3-t-Butoxycarbonylamino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid (cis form), m.p. 239-241°C, white powder (recrystallized from ethanol)

31) 7-[3-(N-t-Butoxycarbonyl-N-ethylaminomethyl)-1-pyrrolidinyl]-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 175-177°C, white powder (recrystallized from ethanol)

32) 7-(3-Amino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid hydrochloride (cis form), m.p. 280-284°C (dec.), pale yellow powder (recrystallized from ethanol)

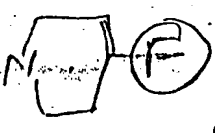
33) 7-(3-Ethylaminomethyl-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid hydrochloride, m.p. 236-239°C, pale yellow powder (recrystallized from ethanol)

34) 7-(1,4-Diazabicyclo[4,3,0]nonan-4-yl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 203-205°C, colorless needles (recrystallized from ethanol)

35) 7-(4-Acetyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 261-263°C, white powder (recrystallized from ethanol)

36) 7-(3-Methylamino-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 194-197°C, white powder (recrystallized from dimethylformamide)

37) 7-(3-t-Butoxycarbonylamino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid (trans form), m.p. 226-229°C, white powder (recrystallized from ethanol)



38) 7-[4-(5-Methyl-2-oxo-1,3-dioxolen-4-yl)methyl-1-piperazinyl]-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

^{1}H-NMR (CDCl$_3$) δppm: 1.14-1.24 (2H, m), 1.26-1.41 (2H, m), 2.16 (3H, s), 2.72-2.84 (7H, m), 3.28-3.53 (7H, m), 7.29 (1H, d, 8.2 Hz), 8.73 (1H, s), 15.57 (1H, s)

39) 7-(4-Benzyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-5,8-dimethyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 165-166°C, pale yellow needles (recrystallized from diethyl ether - ethanol)

40) 7-(4-Benzyl-3-methyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-5,8-dimethyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 176-178°C, pale yellow powder

41) 7-(1,4-Diazabicyclo[4,3,0]nonan-4-yl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 194-197°C, pale yellow needles (recrystallized from dichloromethane - n-hexane)

42) 7-Morpholino-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxcquinoline-3-carboxylic acid, m.p. 255-259°C, white needles (recrystallized from ethanol)

43) 7-(4-Hydroxy-1-piperidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 247-250°C, white needles (recrystallized from ethanol)

44) 7-(4-Fluoro-1-piperidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 259-261°C, pale yellow needles (recrystallized from ethanol)

45) 7-(3-Methylamino-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid monohydrochloride, m.p. 215-219°C, white powder (recrystallized from ethanol)

46) 7-(3-Ethylaminomethyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid monohydrochloride, m.p. 221-223°C, white powder (recrystallized from ethanol)

47) 7-(3-Aminomethyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

48) 7-(3-Amino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid monohydrochloride (cis form), m.p. 209-213°C, pale yellow powder (recrystallized from ethanol)

49) 7-(3-Amino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid monohydrochloride (trans form), m.p. 214-216°C pale yellow powder (recrystallized from ethanol)

50) 7-[4-(5-Methyl-2-oxo-1,3-dioxolen-4-yl)-methyl-1-piperazinyl]-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

51) 7-(4-Acetyl-1-piperazinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 217-220°C, white powder (recrystallized from ethanol)

52) 7-[3-(N-t-Butoxycarbonyl-N-methylamino)-1-pyrrolidinyl]-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 184-187°C, white powder (recrystallized from ethanol)

53) 7-[3-(N-t-Butoxycarbonyl-N-ethylaminomethyl)-1-pyrrolidinyl]-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 147-149°C, white powder (recrystallized from ethanol)

54) 7-[3-(N-t-Butoxycarbonylaminomethyl)-1-pyrrolidinyl]-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid

55) 7-(3-t-Butoxycarbonylamino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid (cis form), m.p. 215-217°C, pale yellow powder (recrystallized from ethanol)

56) 7-(3-t-Butoxycarbonylamino-4-methyl-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid (trans form), m.p. 223-224°C, white powder (recrystallized from ethanol)

57) 7-(3-Amino-1-pyrrolidinyl)-1-cyclopropyl-6-fluoro-8-chloro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 194-195°C, pale yellow powder (recrystallized from ethanol)

58) 7-(1-Piperazinyl)-1-(2,4-difluorophenyl)-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 244-246°C (dec.), white powder (recrystallized from dimethylformamide)

59) 7-(4-Methyl-1-piperazinyl)-1-(2,4-difluorophenyl)-6,8-difluoro-5-methyl-1,4-dihydroxy-4-oxoquinoline-3-carboxylic acid, m.p. 228-230°C (dec.), white powder (recrystallized from ethanol)

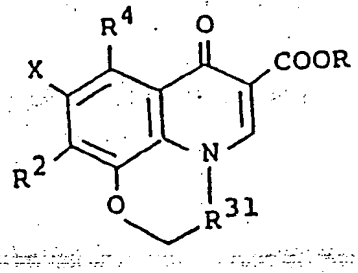
60) 7-(1-Piperazinyl)-1-(4-hydroxyphenyl)-6,8-difluoro-5-methyl-1,4-dihydroxy-4-oxoquinoline-3-carboxylic acid, m.p. >300°C, white powder

61) 7-(4-Methyl-1-piperazinyl)-1-(4-hydroxyphenyl)-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. >300°C, white powder

62) 7-(1-Piperazinyl)-1-ethyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, m.p. 219-220°C (dec.), colorless needles (recrystallized from ethanol)

simultaneously halogen atom, and that when R^3 is hydrogen atom, R^4 is a lower alkyl, or pharmaceutically acceptable salt thereof.

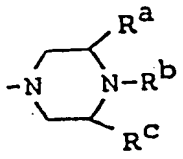
3. The compound according to claim 1, which is a compound of the formula:



[1]

wherein R^2 is a 5-to 8-membered saturated or unsaturated heterocyclic ring which may be sustituted, R^4 is a (lower) alkyl or a halogen atom, R is hydrogen atom or a (lower) alkyl, R^{31} is hydrogen atom or a (lower) alkyl, and X is a halogen atom, or a pharmaceutically acceptable salt thereof.

4. The compound according to claim 3, wherein R^2 is a group of the formula:



wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom, a C_1-C_6 alkyl group, a C_1-C_6 alkanoyl group, a phenyl(C_1-C_6)alkyl group, or a 2-oxo-1,3-dioxolenemethyl group which is substituted by a C_1-C_6 alkyl group, R^c is hydrogen atom or a C_1-C_6 alkyl group, R is hydrogen atom; R^4 is a C_1-C_6 alkyl group; X is fluorine atom; and R^{31} is a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

5. The compound according to claim 2, wherein R^{1A} is a phenyl which may have 1 to 3 substituents selected from the group consisting of a C_1-C_6 alkoxy group, a halogen atom and hydroxy group, or a C_1-C_6 alkyl group which may by substituted by a halogen atom, a C_2-C_6 alkanoyloxy group or hydroxy group, R is hydrogen atom, and X is fluorine atom, or a pharmaceutically acceptable salt thereof.

6. The compound according to claim 2, wherein R^{1A} is a C_2-C_6 alkenyl group or thienyl group, R is hydrogen atom, and X is fluorine atom, or a pharmaceutically acceptable salt thereof.

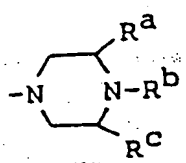
7. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, and R^4 is a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

8. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a C_1-C_6 alkyl group, R^4 is a halogen atom, or a pharmaceutically acceptable salt thereof.

9. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} and R^4 are each a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

10. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, and R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-piperazinyl group which may have 1 to 3 substituents selected from the group consisting of a C_1-C_6 alkyl group, a C_1-C_6 alkanoyl group, a phenyl(C_1-C_6)-alkyl group, and a 2-oxo-1,3-dioxolenemethyl group which may be substituted by phenyl group or a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

11. The compound according to claim 10, wherein R^2 is a group of the formula:



wherein R^a is hycrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom, a C_1-C_6 alkyl group, a C_1-C_6 alkanoyl group, a phenyl(C_1-C_6)alkyl group, or a 2-oxo-1,3-dioxolonomethyl group which is substituted by a C_1-C_6 alkyl group, R^c is hydrogen atom or a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

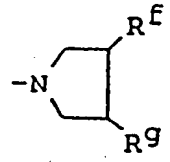
12. The compound according to claim 11, wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom or a C_1-C_6 alkyl group, R^c is hydrogen atom, R^{3A} is fluorine or chlorine atom, and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

13. The compound according to claim 11, wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom or a C_1-C_6 alkyl group, R^c is hydrogen atom, R^{3A} is fluorine or chlorine atom, and R^4 is ethyl group, or a pharmaceutically acceptable salt thereof.

14. The compound according to claim 12 or claim 13, wherein R^{3A} is fluorine atom, or a pharmaceutically acceptable salt thereof.

15. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, and R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-pyrrolidinyl which may have 1 to 3 substituents selected from the group consisting of an amino which may have 1 or 2 susbtituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxy-carbonyl group, an amino(C_1-C_6)alkyl group which may have 1 to 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxycarbonyl group on the amino molety, and a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

16. The compound according to claim 15, wherein R^2 is a group of the formula:

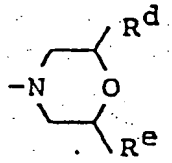


wherein R^f is an amino which may have 1 or 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxy-carbonyl group, or an amino(C_1-C_6)alkyl group which may have 1 or 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxycarbonyl group on the amino molety, R^g is hydrogen atom or a C_1-C_6 alkyl group, R^{3A} is fluorine or chlorine atom, and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

17. The compound according to claim 16, wherein R^{3A} is fluorine atom, and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

18. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is a morpholino group which may have 1 to 3 substituents of C_1-C_6 alkyl groups, or a pharmaceutically acceptable salt thereof.

19. The compound according to claim 18, wherein R^2 is a group of the formula:

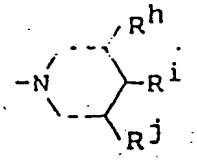


wherein R^d is hydrogen atom or a C_1-C_6 alkyl group, R^e is hydrogen atom or a C_1-C_6 alkyl group, R^{3A} is fluorine or chlorine atom, and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

20. The compound according to claim 19, wherein R^{3A} is fluorine atom and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

21. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-piperidinyl group which may have 1 to 3 substituents selected from a C_1-C_6 alkyl group, hydroxy, a halogen atom and oxo group, or a pharmaceutically acceptable salt thereof.

22. The compound according to claim 21, wherein R^2 is a group of the formula:



wherein R^h is hydrogen atom or a C_1-C_6 alkyl group, R^i is hydroxy, a halogen atom or oxo group, R^j is hydrogen atom or a C_1-C_6 alkyl group; R^{3A} is fluorine or chlorine atom; and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

23. The compound according to claim 22, wherein R^{3A} is fluorine atom and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

24. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is a halogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is 1,4-diazobicyclo[4.3.0]nonan-4-yl group, or a pharmaceutically acceptable salt thereof.

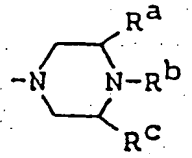
25. The compound according to claim 24, wherein R^{3A} is fluorine or chlorine atom and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

26. The compound according to claim 25, wherein R^{3A} is fluorine atom and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

27. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, and R^4 is a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

28. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-piperazinyl group which may have 1 to 3 substituents selected from a C_1-C_6 alkyl group, a C_1-C_6 alkancyl group, a phenyl(C_1-C_6)-alkyl group, and a 2-oxo-1,3-dioxolenemethyl group which may substituted by phenyl or a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

29. The compound according to claim 28, wherein R^2 is a group of the formula:



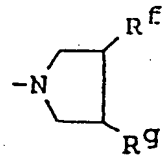
wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom, a C_1-C_6 alkyl group, a C_1-C_6 alkanoyl group, a phenyl(C_1-C_6)alkyl group, or a 2-oxo-1,3-dioxolenemethyl group which is substituted by a C_1-C_6 alkyl group, R^c is hydrogen atom or a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

30. The compound according to claim 29, wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom or a C_1-C_6 alkyl group, R^c is hydrogen atom, and R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

31. The compound according to claim 30, wherein R^a is hydrogen atom or a C_1-C_6 alkyl group, R^b is hydrogen atom or a C_1-C_6 alkyl group, R^c is hydrogen atom, and R^4 is ethyl group, or a pharmaceutically acceptable salt thereof.

32. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, and R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-pyrrolidinyl which may have 1 to 3 substituents selected from the group consisting of an amino which may have 1 or 2 susbtituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxy-carbonyl group, an amino(C_1-C_6)alkyl group which may have 1 to 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxy-carbonyl group on the amino moiety, and a C_1-C_6 alkyl group, or a pharmaceutically acceptable salt thereof.

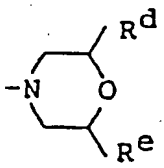
33. The compound according to claim 32, wherein R^2 is a group of the formula:



wherein R^f is an amino which may have 1 or 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxy-carbonyl group amino(C_1-C_6)alkyl group which may have 1 or 2 substituents selected from a C_1-C_6 alkyl group and a (C_1-C_6)alkoxycarbonyl group on the amino moiety, R^g is hydrogen atom or a C_1-C_6 alkyl group, and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

34. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is a morpholino group which may have 1 to 3 substituents of C_1-C_6 alkyl groups, or a pharmaceutically acceptable salt thereof.

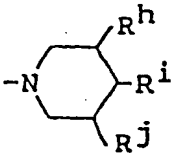
35. The compound according to claim 34, wherein R^2 is a group of the formula:



wherein R^d is hydrogen atom or a C_1-C_6 alkyl group, R^e is hydrogen atom or a C_1-C_6 alkyl group, and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

36. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is a 1-piperidinyl group which may have 1 to 3 substituents selected from a C_1-C_6 alkyl group, hydroxy, a halogen atom and oxo group, or a pharmaceutically acceptable salt thereof.

37. The compound according to claim 36, wherein R^2 is a group of the formula:



wherein R^h is hydrogen atom or a C_1-C_6 alkyl group, R^i is hydrogen atom, hydroxy, a halogen atom or oxo group, R^j is hydrogen atom or a C_1-C_6 alkyl group; and R^4 is methyl or ethyl group, or a pharmaceutically acceptable salt thereof.

38. The compound according to claim 2, wherein R^{1A} is unsubstituted cyclopropyl, R is hydrogen atom, X is fluorine atom, R^{3A} is hydrogen atom, R^4 is a C_1-C_6 alkyl group, and R^2 is 1,4-diazobicyclo[4.3.0]nonan-4-yl, or a pharmaceutically acceptable salt thereof.

39. The compound according to any one of claims 33, 35, 37 and 38, wherein R^4 is methyl group, or a pharmaceutically acceptable salt thereof.

40. 7-(1-Piperazinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid.

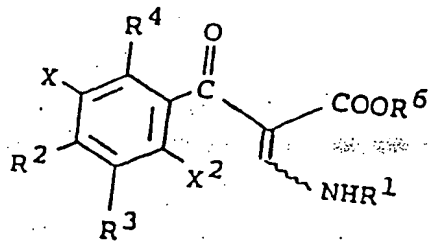
41. 7-(3-Methyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid.

42. 7-(4-Methyl-1-piperazinyl)-1-cyclopropyl-6-fluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid.

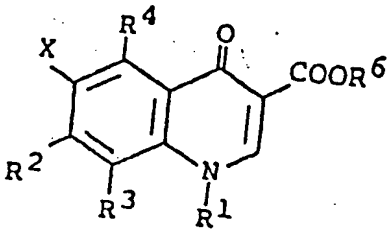
43. The compound according to claim 1, which is a member selected from the group consisting of 7-(1-piperazinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, 7-(3-methyl-1-piperazinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, 7-(3-amino-1-pyrrolidinyl)-1-cyclopropyl-6,8-difluoro-5-methyl-1,4-dihydro-4-oxoquinoline-3-carboxylic acid, and 3S(-)-10-(4-methyl-1-piperazinyl)-9-fluoro-3,8-dimethyl-7-oxo-7H-pyrido[1,2,3-de][1,4]benzoxazine-6-carboxylic acid.

44. A process for preparing the compound as set forth in claim 1, which comprises

(a) subjecting a compound of the formula:

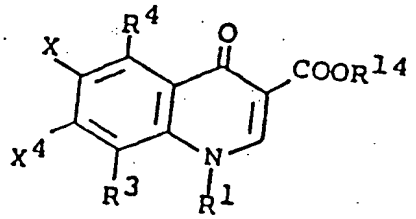


wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1, X^2 is a halogen atom, and R^6 is a lower alkyl, to cyclization reaction to give a compound of the formula:

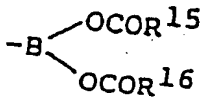


wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1, and R^6 is as defined above, optionally followed by hydrolysis of the above compound,

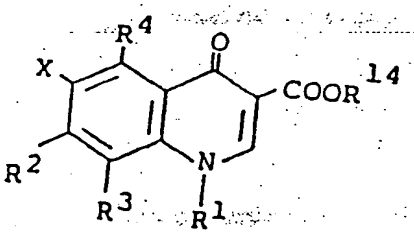
(b) reacting a compound of the formula:



wherein R^1, R^3, R^4 and X are as defined in claim 1, X^4 is a halogen atom, and R^{14} is hydrogen atom or a group of the formula:

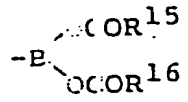


(wherein R^{15} and R^{16} are each an alkyl), with a compound of the formula: R^2H wherein R^2 is as defined in claim 1 to give a compound of the formula:



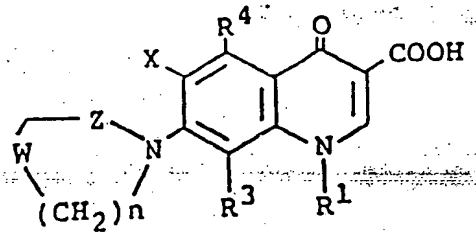
wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1, and R^{14} is as defined above, optionally followed

converting the compound where R^{14} is a group of the formula:



into a compound where R^{14} is hydrogen atom.

(c) reacting a compound of the formula:

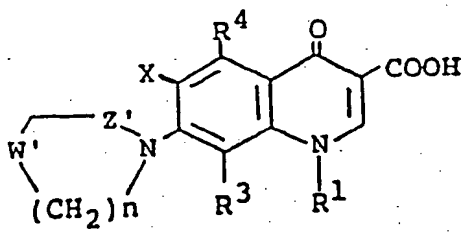


wherein R^1, R^3, R^4 and X are as defined in claim 1, either Z or W is $-CH_2-$ and the other is -NH, n is an integer of 1 to 3, with a compound of the formula:

$R^{17}X^5$

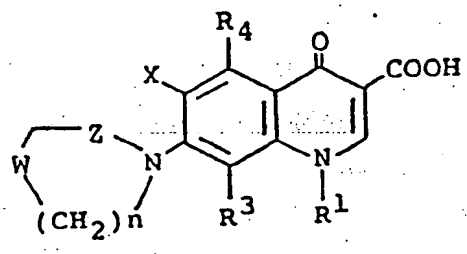
wherein R^{17} is a (lower) alkyl; a cycloalkyl; a phenyl (lower) alkyl in which phenyl ring may be substituted by a (lower) alkoxy, nitro or amino; a phenyl which may be substituted by a halogen atom, a (lower) alkyl or a (lower) alkyl which may be substituted by 1 to 3 of halogen atoms; a pyridyl; a (lower) alkyl having 1 to 3 substituents selected from the group consisting of hydroxy, amino, a (lower) alkoxy and a halogen atom, said amino being optionally substituted by a (lower) alkyl, a (lower) alkanoyl, a cycloalkyl or a (lower) alkoxycarbonyl; a (lower) alkanoyl which may be substituted by 1 to 7 of halogen atoms; a (lower) alkenylcarbonyl having 1 to 3 substituents selected from the group consisting of a halogen atom and a carboxy; a (lower) alkoxycarbonyl; an aminocarbonyl which may be substituted by a (lower) alkyl; a phenyl-(lower)alkoxycarbonyl; an amino(lower)alkanoyl which may be substituted by a phenyl(lower)alkoxycarbonyl; a (lower) alkoxycarbonyl(lower)alkyl; a carboxy(lower)alkyl; an anilinocarbonyl(lower)alkyl; a (lower) alkylsulfonyl which may be substituted by 1 to 3 halogen atoms; a sulfo(lower)alkyl; a (lower) alkenyl or a (lower) alkynyl, and X^5 is a halogen atom.

to give a compound of the formula:



wherein R^1, R^3, R^4 and X are as defined in claim 1, n is as defined above, and either Z' or W' is $-CH_2-$ and the other is $-NR^{17}$ (R^{17} is as defined above),

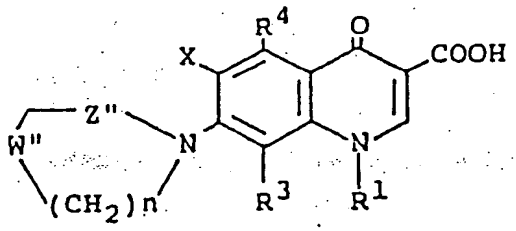
(d) reacting a compound of the formula:



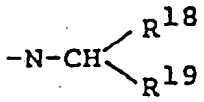
wherein R^1, R^3, R^4 and X are as defined in claim 1, and W, Z and n are as defined above, with a compound of the formula:

$R^{18}COR^{19}$

wherein R^{18} and R^{19} are each hydrogen atom or a lower alkyl, to give a compound of the formula:

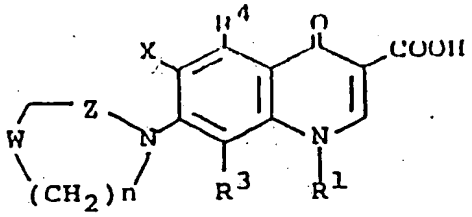


wherein R^1, R^3, R^4 and X are as defined in claim 1, n is as defined above, and either Z" or W" is $-CH_2-$ and the other is

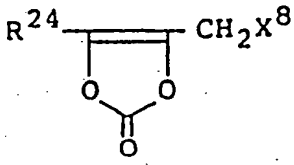


(R^{18} and R^{19} are as defined above),

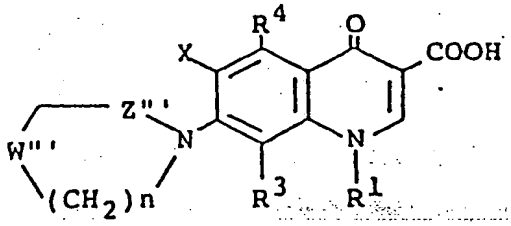
(e) reacting a compound of the formula:



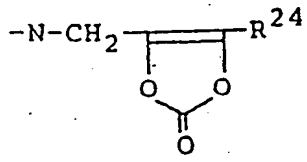
wherein R^1, R^3, R^4 and X are as defined in claim 1, and W, Z and n are as defined above, with a compound of the formula:



wherein R^{24} is phenyl, a lower alkyl or hydrogen atom, X^8 is a halogen atom, to give a compound of the formula:

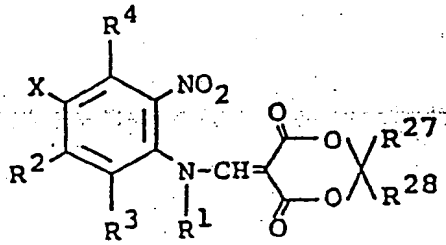


wherein R^1, R^3, R^4 and X are as defined in claim 1, n is as defined above, either Z" or W" is $-CH_2-$ and the other is a group:

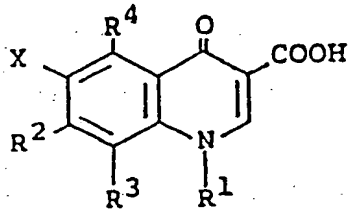


(R^{24} is as defined above),

(f) subjecting a compound of the formula:

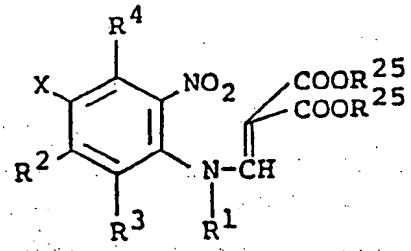


wherein R^1, R^2, R^3, R^4 and X is as defined in claim 1, and R^{26} and R^{27} are each a lower alkyl, to a cyclization reaction to give a compound of the formula:

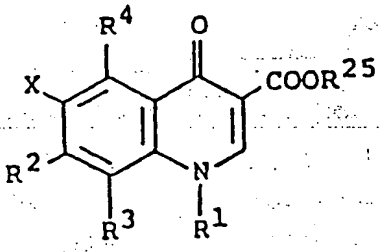


wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1,

(g) subjecting a compound of the formula:



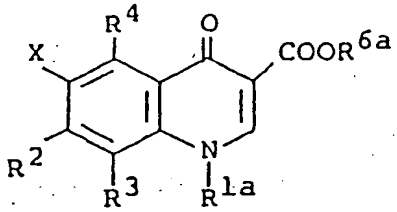
wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1, and R^{25} is a lower alkyl, to cyclization reaction to give a compound of the formula:



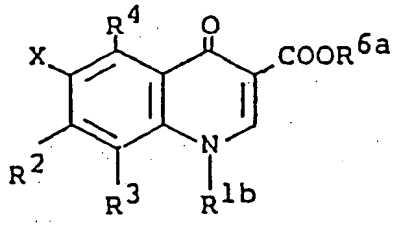
wherein R^1, R^2, R^3, R^4 and X are as defined in claim 1, and R^{24} are as defined above, optionally followed

by hydrolysis thereof,

(h) reacting a compound of the formula:

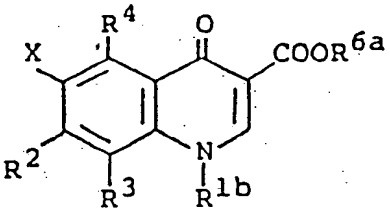


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{1a} is a (lower) alkyl having 1 to 3 hydroxy groups, and R^{6a} is hydrogen atom or a (lower) alkyl, with a (lower) alkanoylating agent, to give a compound of the formula:

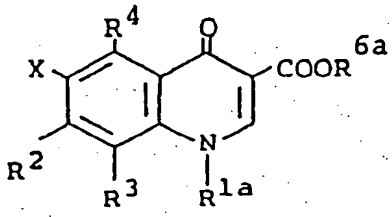


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{6a} is as defined above, and R^{1b} is a (lower) alkyl having 1 to 3 (lower) alkanoyloxy groups,

(i) subjecting a compound of the formula:

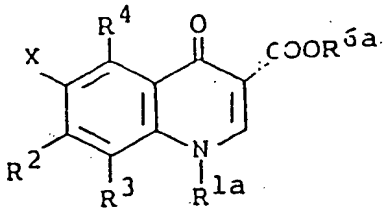


wherein R^2, R^3, R^4 and X are as defined in claim 1, and R^{1b} and R^{6a} are as defined above, to hydrolysis to give a compound of the formula:

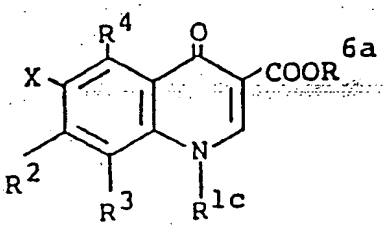


wherein R^2, R^3, R^4 and X are as defined in claim 1, and R^{1a} and R^{6a} are as defined above,

(j) reacting a compound of the formula:

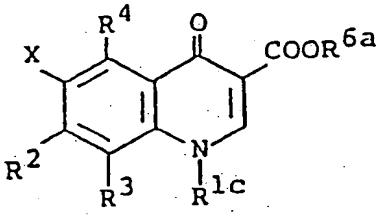


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{1a} and R^{6a} are as defined above, with a halcgenating agent, to give a compound of the formula:

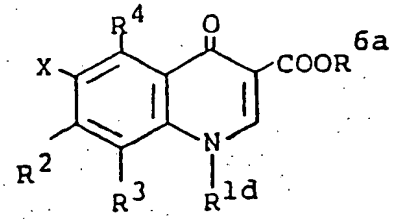


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{6a} is as defined above, and R^{1c} is a (lower) alkyl having 1 to 3 halogen atoms,

(k) treating a compound of the formula:

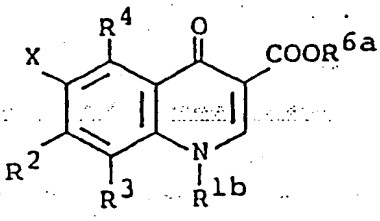


wherein R^2, R^3, R^4 and X are as defined in claim 1, and R^{1c} and R^{6a} are as defined above, with a basic compound to give a compound of the formula:

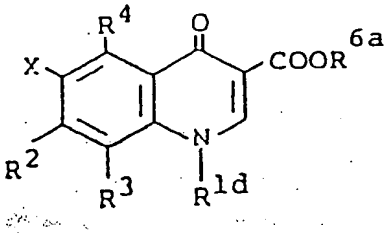


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{6a} is as defined above, and R^{1d} is a (lower) alkenyl,

(l) converting a compound of the formula:

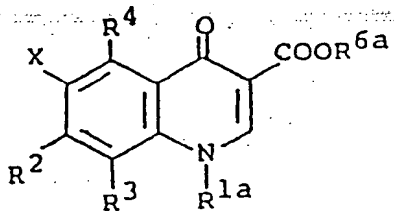


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{1b} and R^{6a} are as defined above, to a compound the formula:

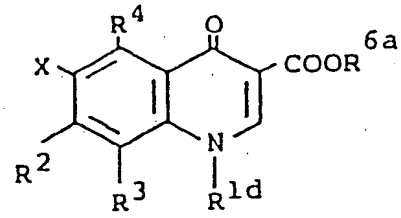


wherein R^2, R^3, R^4 and X are as defined in claim 1, R^{1d} and R^{6a} are as defined above, or

(m) converting a compound of the formula:



wherein R^2, R^3, R^4 and X are as defined in claim 1, and R^{1a} and R^{6a} are as defined above, in the presence of an acid to a compound of the formula:



wherein R^2, R^3, R^4 and X are as defined in claim 1, and R^{1d} and R^{6a} are as defined above.

45. An antimicrobial composition which comprises as an essential active ingredient an effective amount of a compound as set forth in claim 1.

46. Use of the compound as set forth in claim 1 as an antimicrobial agent.